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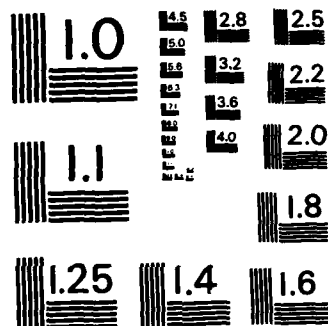
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MITRE Technical Report
MTR-7610
Volume II

Airport and Airway Cost Projections: 1977-1986

Part I: Development of FAA Costs

R. L. FAIN

SEPTEMBER 1977

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ABSTRACT

Two forecasts of expenditures by the Federal Aviation Administration (FAA) in support of the Airport and Airway System are developed as part of the study on Airport and Airway Costs and User Cost Responsibility during the period FY77 through FY86. Baseline projections assume the continuation of historical relationships between expenditures and aviation activity levels. Alternative projections estimate the costs of incorporating currently planned Upgraded Third Generation Air Traffic Control enhancements. Major categories of FAA expenditures and several cost projection options are discussed.

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CONCLUSIONS

The Federal Aviation Administration can expect to spend a total of \$26.8 billion (in constant FY76 dollars) during FY77 through FY86 if historical relationships between expenditures and aviation activity levels continue throughout that time period. Of this total, \$18.4 billion is allocated to the operations and maintenance (\$12.2 billion) and associated support (\$6.2 billion) functions of the Airport and Airway System. Capital investments in facilities and equipment amount to \$2.5 billion. The balance (\$8.4 billion) represents expenditures on (1) research and development, (2) facilities, engineering and development, (3) national capital airports and (4) grants-in-aid programs.

The introduction of planned Upgraded Third Generation (UG3RD) Air Traffic Control enhancements during this same period will require additional capital investments of \$620 million. The resulting increases in controller productivity and reductions in operations and maintenance requirements will realize total savings of \$775.5 million in operations and maintenance costs and \$290.2 million in support costs. Net savings due to UG3RD improvements begin in FY81 and grow to a level of 7.4% per year by FY86.

TABLE OF CONTENTS

	<u>Page</u>
1. INTRODUCTION	1-1
1.1 Scope of Cost Bases	1-1
1.2 Alternative Cost Bases	1-1
2. DESCRIPTION OF THE FAA COST BASE	2-1
2.1 Research and Development	2-1
2.2 Facilities and Engineering	2-1
2.3 Operations	2-1
2.4 Maintenance	2-1
2.5 Support	2-1
2.5.1 Installation and Material Services	2-3
2.5.2 Administration of Flight Standards Programs	2-3
2.5.3 Administration of Medical Program	2-3
2.5.4 Development Direction	2-3
2.5.5 Administration of Airports	2-3
2.5.6 Centralized Training	2-3
2.5.7 Direction, Staff and Support	2-4
2.6 Facilities, Engineering and Development	2-4
2.7 National Capitol Airports	2-4
2.8 Grants-in-Aid	2-4
3. OPTIONS IN PROJECTING COSTS	3-1
3.1 Amortization of Capital	3-1
3.2 Cost Projection Methods	3-2
3.2.1 Econometric Models	3-2
3.2.2 Engineering Model	3-3
4. COST PROJECTION PROCEDURES	4-1
4.1 Baseline Cost Procedures	4-1
4.2 Alternative Cost Procedures	4-2
5. RESULTS	5-1

TABLE OF CONTENTS
(concluded)

	<u>Page</u>
APPENDIX A: AMORTIZED COST PROJECTIONS	A-1
APPENDIX B: FAA STAFFING ESTIMATES	B-1
APPENDIX C: GLOSSARY	C-1
APPENDIX D: REFERENCES	D-1
APPENDIX E: DISTRIBUTION LIST	E-1

LIST OF ILLUSTRATIONS

	<u>Page</u>
TABLE 2-1: MAJOR CATEGORIES OF FAA EXPENDITURES	2-2
TABLE 4-1: CONTROLLER PRODUCTIVITY FACTORS	4-4
TABLE 5-1: BASELINE TOTAL COSTS, FY76 CONSTANT DOLLARS (MILLIONS)	5-2
TABLE 5-2: BASELINE TOTAL COSTS, CURRENT DOLLARS (MILLIONS)	5-3
TABLE 5-3: ALTERNATIVE TOTAL COSTS, FY76 CONSTANT DOLLARS (MILLIONS)	5-4
TABLE 5-4: ALTERNATIVE TOTAL COSTS, CURRENT DOLLARS (MILLIONS)	5-5
TABLE A-1: AMORTIZED BASELINE COST PROJECTIONS (FY76 CONSTANT DOLLARS IN THOUSANDS)	A-2
TABLE A-2: AMORTIZED BASELINE COST PROJECTIONS (CURRENT DOLLARS IN THOUSANDS)	A-4
TABLE A-3: AMORTIZED ALTERNATIVE COST PROJECTIONS (FY76 CONSTANT DOLLARS IN THOUSANDS)	A-6
TABLE A-4: AMORTIZED ALTERNATIVE COST PROJECTIONS (CURRENT DOLLARS IN THOUSANDS)	A-8
TABLE B-1: BASELINE STAFFING ESTIMATES	B-2
TABLE B-2: ALTERNATIVE STAFFING ESTIMATES	B-4

1. INTRODUCTION

This report explains the development of cost projections for the Airport and Airway System. It represents one part of a cost allocation study being performed by The MITRE Corporation for the Office of Aviation Policy of the Federal Aviation Administration (FAA).

1.1 Scope of Cost Bases

FAA costs are projected for the period FY77 through FY86. They include research and development, facilities and equipment, operations and maintenance, support, grants-in-aid and national capitol airports expenditures. Each cost category is forecast at a level of detail commensurate with the cost allocation effort.

1.2 Alternative Cost Bases

The problem of estimating future FAA system costs of the next ten years is compounded with the introduction of improved capital-intensive air traffic control technology collectively named the Upgraded Third Generation Air Traffic Control (UG3RD ATC) System. Hence, two comparable cost bases are developed. The first is a baseline set of projections which assume that historical relationships between costs and aviation activity levels will continue throughout the analysis period. The alternative cost base forecasts the investment costs and operational cost savings of incorporating currently planned UG3RD enhancements.

The following sections will, in turn, discuss the major categories of FAA expenditures, several cost projection options and finally, the evolution of the two bases.

2. DESCRIPTION OF THE FAA COST BASE

The FAA cost base is projected in categories compatible with both Congressional budget appropriations and cost allocation methods. Table 2-1 outlines the structure of FAA expenditures within which the cost bases are developed. Those programs included under Maintenance and Support are normally part of the Operations appropriations. However, they are extracted and grouped in separate categories to facilitate cost generation and allocation.

2.1 Research and Development (R&D)

The research and development program of the FAA is devoted to the adaptation of current technology and the development of new technology in areas of air traffic control, navigation, weather and medicine. R&D objectives are the continued modernization of the system in order to accommodate increasing user demands safely and efficiently.

2.2 Facilities and Engineering (F&E)

Capital expenditures in the procurement, rehabilitation and replacement of new equipment and the construction, relocation and modernization of facilities are financed by the F&E program. Major investment areas include surveillance systems, computer automation, communication systems, navigation systems, landing systems, housing and utilities, inspection and training, development, test and evaluation facilities and aircraft.

2.3 Operations

The personnel costs of staffing the operational elements of the Airport and Airway System comprise the operations budget. The largest portion of expenditures in this category pay the salaries of air traffic controllers at en route centers and control towers and the salaries of flight service station staff.

2.4 Maintenance

The maintenance budget provides for the management and engineering services required to sustain and improve the operation of air traffic control and air navigation, facilities and equipment.

2.5 Support

The following support elements of the FAA cost base are a grouping of costs funded in the operations appropriation but which are related to R&D, F&E, Maintenance and Grants-in-Aid programs.

2.5.1 Installation and Material Services (I&M)

The FAA's procurement, contracting and material management activities are financed by this program. This includes (1) leased communications for operational and administrative elements of the system, (2) supply support for all aircraft except those used in R&D and (3) charges for space provided by the General Services Administration.

2.5.2 Administration of Flight Standards Programs

The primary responsibility of the Flight Standards Program is the administration and promotion of safety standards. Included in this activity are the (1) publication and distribution of safety regulations, (2) development of certain flight procedures, (3) monitoring navigational aids, (4) the registration of airmen and aircraft and (5) conduct of the civil aviation security program.

2.5.3 Administration of Medical Program

FAA medical activities insure the physical and mental fitness of airmen and controllers through a program of physical examination and certification. In addition are the costs of administering the aviation medical research program, investigation of aircraft accidents, supervising the FAA occupational health programs and the specialized training of private physicians.

2.5.4 Development Direction

This category encompasses the costs of planning, directing and evaluating all R&D and Facility, Engineering and Development (F,E&D) programs except for aviation medicine.

2.5.5 Administration of Airports

This program provides the resources necessary to assure compliance with Federal policies regarding airports. It includes (1) participation in airport planning, (2) administration of grants-in-aid for airports, (3) development of airport engineering and safety standards, (4) participation in transfers of Federal land and property, (5) collection and processing of airport data, (6) enforcement of Federal assistance agreements and (7) safety certification of airports.

2.5.6 Centralized Training

Technical, managerial and general training of FAA personnel is

financed by this program. Costs include (1) salaries of teaching and support staff, (2) facilities, supplies and equipment, (3) management of training programs, (4) student travel, (5) tuition and contractual training and (6) costs of maintaining aircraft used in training.

2.5.7 Direction, Staff and Support

This activity provides the overall control of FAA programs and policies at federal and regional headquarters. Included are the costs of FAA management, administration, finance, personnel support functions and the operations and maintenance of headquarters facilities.

2.6 Facilities, Engineering and Development (F,E&D)

F,E&D resources are used for purchase of equipment and for engineering and development services in support of the FAA's regulatory mission. Activities include (1) development of aircraft safety regulations and methods to deter aircraft sabotage, (2) aeromedical research and development toward elimination of human factors which endanger flight safety and (3) development of regulations to minimize undesired environmental effects.

2.7 National Capitol Airports

Two federally owned airports, Washington National and Dulles International, are supported by direct appropriations. These funds cover all expenses for operations, maintenance and investments in equipment and minor construction.

2.8 Grants-in-Aid

The amended Airport and Airway Development Act of 1970 establishes two financial assistance programs for airports. The Airport Planning Grant Program (PGP) authorizes grants for airport system planning (up to 75%) and airport master planning (up to 90%). The Airport Development Aid Program (ADAP) apportions grants between air carrier and general aviation sponsors for development and improvement of civil airports.

3. OPTIONS IN PROJECTING COSTS

This section examines two issues that directly impact the development of FAA cost projections. The first addresses how "sunk" capital investments in the Airport and Airway System might be charged to the users and the second discusses alternative methods of projecting the cost bases.

3.1 Amortization of Capital

Capital expenditures (F&E and R&D) by the FAA in the development, acquisition and replacement of inventory intended for service over a period of several years may be charged to users of that service in one of two ways. The entire cost of an asset may be passed to the users at the time of purchase or it may be amortized, or "spread", over the useful life of the asset. Three options, then, can be examined in the treatment of capital costs. The first assumes no amortization whatsoever by confining the cost to users of an asset to the year it is incurred. The second assumes amortization of only those costs yet to be contracted (1977 and beyond) and the third also includes the amortized portions of past expenses (pre-1977 sunk costs). In keeping with the previous cost allocation study, these options are labeled Format I, II, and III, respectively (Reference 1).

Format I is, by far, the simplest representation. Nothing more is required than to project the FAA cost base. It avoids making judgements on how to estimate equipment lives, sunk costs and cost recovery factors. Cost recovery schemes based on this format recover the actual expenses in the year incurred, thus maintaining the available capital. This concept intuitively suffers, however, in that future users benefit from capital expenditures at no direct cost to themselves. Major inequities of this nature may arise if capital spending is not essentially level over time.

Format II amortizes only the capital costs of assets purchased during the study period FY77-FY86. It therefore becomes necessary to estimate the useful lives of all new purchases. Furthermore, since actual current costs are spread into the future, annual outlays by the users remain small in the early years of the program and build toward the total annual level of actual expenditures over an extended period of time. Consequently, the FAA must acquire the necessary capital to make up the difference between income from user sources and current expenditures through a combination of financing from General Funds and amortized repayment through the User Trust Fund. The opportunity cost of using that capital is passed to the aviation community in

In 1976, Administrative Sciences Corporation (ASC), under sub-contract to the Office of Aviation Policy of the Federal Aviation Administration, developed and programmed an econometric model (Reference 4) for the explicit purpose of generating "baseline" projections of FAA staff and budget requirements based on given sets of aviation activity forecasts. Most costs are estimated analytically in the ASC model via Cobb-Douglas production functions. Those costs found to be unrelated to aviation activity levels (or any other reasonable variable) are handled simply as throughputs based on FAA budget sources, general trends, congressional testimony, appropriations and the like.

3.2.2 Engineering Model

In contrast to aggregate econometric models, component pricing is a completely disaggregate, or "bottom up," approach to forecasting. It is basically an accounting process that tracks the costs associated with all elements of the Airport and Airway System during its evolution to meet the demands of users throughout the forecast period. In principle, the procedure is straightforward. Unit costs related to development, maintenance, replacement, acquisition, operations and retirement are assembled for all components of the FAA physical plant expected to exist during the forecast period. An implementation (and attrition) scenario is generated for each component such that the overall system configuration can provide traffic control services to satisfy forecast user activity levels. The total cost for each component is merely the sum of the products of its various unit costs and the respective number of units producing those costs. Total system costs are simply the sum of the costs of the system components.

Because costs are formulated irrespective of historical relationships to user demand, the primary feature of component pricing in projecting FAA costs is the ability to directly incorporate UG3RD technological changes that effect production efficiency. In addition, since costs are generated at the component level, they can be easily grouped into any hierarchy consistent with methods being used for cost allocation.

The advantages are gained at a high price. The amount of data that must be obtained and manipulated is enormous for any system as large and complex as that of the FAA. Operational inventories must be assessed. New authorized inventories must be forecast and relevant unit costs (e.g., F&E and O&M) must be determined that reflect not only facility types but also special conditions of application. In addition, the economic life cycle of each element must be determined. Often this type of data is

TABLE B-2
(Continued)

FY	1983	1984	1985	1986
TOTAL	63246	63479	62445	62446
P & D	945	945	945	945
F & E	1500	1500	1500	1500
CENTERS	0	0	0	0
TOWERS	0	0	0	0
FSS	0	0	0	0
NAVAIDS	0	0	0	0
OTHER	0	0	0	0
D & M	45486	45570	44525	44375
TR CNTRL	29309	29426	27888	27208
CENTERS	10996	10702	9485	8930
TOWERS	13213	13224	13003	12978
FSS	4600	4500	4400	4300
OTHER	1000	1000	1000	1000
MAINTNCE	15677	16144	16637	17167
CENTERS	8157	8399	8665	8979
TOWERS	6426	6619	6811	6990
OTHER	1094	1126	1161	1198
SUPPORT	14283	14432	14443	14594
IN & MAT	1574	1555	1462	1424
ADM F ST	5934	6121	6291	6461
ADM MED	366	375	387	401
DEV DIR	225	225	225	225
A-P ADM	948	969	990	1008
CENT TRN	1213	1217	1192	1189
DIR. S&S	3963	3970	3896	3886
FAC E&D	187	187	187	187
NTL C-AP	345	345	345	345
GRANTS	0	0	0	0

TABLE B-1
(Continued)

FY	1983	1984	1985	1986
TOTAL	67319	68806	70412	72115
R & D	945	945	945	945
F & E	1500	1500	1500	1500
CENTERS	0	0	0	0
TOWERS	0	0	0	0
FSS	0	0	0	0
NAVAIDS	0	0	0	0
OTHER	0	0	0	0
O & M	48991	50152	51380	52693
TR CNTPL	33314	34008	34743	35526
CENTERS	13304	13699	14134	14646
TOWERS	14410	14809	15209	15580
FSS	4600	4500	4400	4300
OTHER	1000	1000	1000	1000
MAINTNCE	15677	16144	16637	17167
CENTERS	8157	8399	8665	8979
TOWERS	6426	6619	6811	6990
OTHER	1094	1126	1161	1198
SUPPORT	14851	15177	15555	15945
IN & MAT	1801	1853	1907	1965
ADM F ST	5994	6121	6291	6461
ADM MED	366	375	387	401
DEV DIP	225	225	225	225
A-P ADM	948	969	990	1008
CENT TPN	1303	1335	1368	1403
DIR. S&S	4214	4299	4387	4482
FAC EXD	187	187	187	187
NLT C-AP	845	845	845	845
GRANTS	0	0	0	0

APPENDIX B

FAA STAFFING ESTIMATES

An intermediate product of the ASC econometric cost projection model (Reference 2) are staffing estimates from which much of the cost base is derived. Table B-1 displays baseline staffing projections that might be expected if historical trends were to continue. Table B-2 presents similar projections adjusted to reflect productivity gains associated with implementation of the alternative UG3RD enhancements.

TABLE A-4
(Continued)

FY	1982	1983	1984	1985	1986
TOTAL	3681126.	3925193.	4199976.	4440031.	4731186.
R & D	105952.	111673.	117691.	124378.	130991.
F & E	288257.	357942.	432072.	519414.	613826.
CENTERS	46400.	55077.	68682.	92446.	120649.
TOWERS	108404.	142169.	172668.	206477.	242587.
FSS	48803.	56799.	64065.	69868.	76466.
NAVAIDS	59885.	73611.	89634.	107096.	122659.
OTHER	24766.	30285.	37023.	43527.	51464.
D & M	1678872.	1761974.	1863139.	1927477.	2026604.
TR CNTRL	1066900.	1103712.	1148199.	1148259.	1179175.
CENTERS	419458.	426679.	437672.	409934.	406471.
TOWERS	456644.	482910.	509338.	529293.	556338.
FSS	143662.	148197.	152789.	157882.	162496.
OTHER	47138.	45926.	48401.	51151.	53870.
MAINTNCE	611972.	658262.	714941.	779218.	847429.
CENTERS	325486.	351420.	381346.	415777.	453750.
TOWERS	253874.	276845.	300527.	326816.	353237.
OTHER	32612.	29998.	33067.	36625.	40442.
SUPPORT	863543.	915350.	969872.	1012172.	1068839.
IN & MAT	215323.	223681.	232890.	231403.	237371.
ADM F ST	240310.	260188.	280020.	304150.	328976.
ADM MED	14934.	16367.	17673.	19274.	21034.
DEV DIR	10820.	11404.	12019.	12701.	13377.
A-P ADM	36411.	39078.	42096.	45452.	48739.
CENT TRN	124771.	131725.	139282.	144172.	151455.
DIR. S&S	220975.	232907.	245892.	255019.	267888.
FAC E&D	29015.	30581.	32229.	34061.	35872.
NTL C-AP	40488.	42674.	44974.	47530.	50057.
GRANTS	675000.	704999.	740000.	775000.	804999.

TABLE A-3
(Continued)

FY	1982	1983	1984	1985	1986
TOTAL	2530570.	2618448.	2668981.	2674923.	2711556.
R & D	74300.	74300.	74300.	74300.	74300.
F & E	211669.	252704.	293766.	336155.	377678.
CENTERS	32301.	36647.	43813.	55911.	69536.
TOWERS	78190.	98416.	114977.	130860.	146471.
FSS	37000.	41581.	45340.	47336.	49333.
NAVAIDS	45402.	53888.	63435.	72558.	79135.
OTHER	18776.	22171.	26202.	29490.	33203.
D & M	1177330.	1172305.	1176225.	1151420.	1149521.
TR CNTRL	748177.	734340.	724874.	685938.	668846.
CENTERS	294150.	283885.	276308.	244883.	230557.
TOWERS	220227.	321298.	321552.	316185.	315563.
FSS	100744.	98601.	96457.	94314.	92170.
OTHER	33056.	30556.	30556.	30556.	30556.
MAINTNCE	429153.	437965.	451352.	465483.	480675.
CENTERS	228251.	233812.	240749.	248374.	257374.
TOWERS	178032.	184195.	189727.	195231.	200361.
OTHER	22870.	19958.	20876.	21879.	22939.
SUPPORT	605571.	609015.	612293.	604643.	606262.
IN & MAT	150998.	148823.	147027.	138234.	134641.
ADM F ST	168521.	173113.	176781.	181690.	186600.
ADM MED	10473.	10889.	11157.	11514.	11931.
DEV DIR	7587.	7587.	7587.	7587.	7587.
A-P ADM	25534.	26000.	26576.	27152.	27645.
CENT TRN	87497.	87642.	87931.	86124.	85908.
DIR. S&S	154961.	154961.	155235.	152341.	151950.
FAC E&D	20347.	20347.	20347.	20347.	20347.
NTL C-AP	28393.	28393.	28393.	28393.	28393.
GRANTS	462963.	461387.	463659.	459668.	455059.

TABLE A-2
(Continued)

FY	1982	1983	1984	1985	1986
TOTAL	3737244.	4090061.	4420038.	4790941.	5173310.
R & D	105952.	111673.	117691.	124378.	130991.
F & E	253097.	304181.	359925.	423988.	492220.
CENTERS	66907.	79564.	93957.	112758.	133747.
TOWERS	91038.	109631.	129513.	151897.	176390.
FSS	29321.	36238.	44302.	52151.	58289.
NAVAIDS	42787.	50905.	59237.	68501.	78660.
OTHER	23045.	27843.	32916.	38681.	45134.
D & M	1783330.	1923820.	2076835.	2249955.	2431808.
TR CNTPL	1160520.	1248424.	1343837.	1451654.	1564261.
CENTERS	478203.	516259.	560242.	610843.	666643.
TOWERS	484246.	526620.	570368.	619057.	667873.
FSS	143662.	148197.	152799.	157982.	162496.
OTHER	54410.	57348.	60439.	63873.	67269.
MAINTNCE	622810.	675396.	732998.	798302.	867528.
CENTERS	325486.	351420.	381346.	415777.	453750.
TOWERS	253874.	276845.	300527.	326816.	353237.
OTHER	43450.	47132.	51125.	55709.	60540.
SUPPORT	900365.	972134.	1048385.	1136031.	1227366.
IN & MAT	236222.	255940.	277521.	301837.	327552.
ADM F ST	240310.	260188.	280020.	304150.	328976.
ADM MED	14934.	16367.	17673.	19274.	21034.
DEV DIP	10820.	11404.	12019.	12701.	13377.
A-P ADM	36411.	39078.	42096.	45452.	48739.
CENT TRN	131159.	141499.	152787.	165459.	178714.
DIP, S&S	230510.	247658.	266270.	287159.	308975.
FAC E&D	29015.	30581.	32229.	34061.	35872.
NLT C-AP	40488.	42674.	44974.	47530.	50057.
GRANTS	675000.	704999.	740000.	775000.	804999.

TABLE A-1
(Continued)

FY	1982	1983	1984	1985	1986
TOTAL	2652357.	2724216.	2802437.	2877812.	2954694.
R & D	74300.	74300.	74300.	74300.	74300.
F & E	184382.	213010.	242748.	272413.	301060.
CENTERS	46578.	52941.	59935.	68196.	77085.
TOWERS	65664.	75892.	86241.	96268.	106502.
FSS	22230.	26529.	31353.	35332.	37606.
NAVAIDS	32439.	37266.	41923.	46410.	50748.
OTHER	17471.	20383.	23295.	26207.	29119.
O & M	1250583.	1279987.	1311134.	1344060.	1379358.
TR CNTRL	813830.	830622.	848383.	867177.	887234.
CENTERS	335346.	343436.	353639.	364900.	373130.
TOWERS	339583.	350379.	360081.	369807.	378828.
FSS	100744.	98601.	96457.	94314.	92170.
OTHER	38156.	38156.	38156.	38156.	38156.
MAINTNCE	436753.	449365.	462752.	476883.	492075.
CENTERS	228251.	233812.	240749.	248374.	257374.
TOWERS	178032.	184195.	189727.	195231.	200361.
OTHER	30470.	31358.	32276.	33279.	34339.
SUPPORT	631392.	646796.	661360.	678633.	696181.
IN & MAT	165653.	170286.	175203.	180309.	185793.
ADM F ST	168521.	173113.	176781.	181690.	186600.
ADM MED	10473.	10889.	11157.	11514.	11931.
DEV DIR	7587.	7587.	7587.	7587.	7587.
A-P ADM	25534.	26000.	26576.	27152.	27645.
CENT TRN	91977.	94144.	96456.	98841.	101370.
DIR, S&S	161648.	164776.	168100.	171540.	175255.
FAC E&D	20347.	20347.	20347.	20347.	20347.
NTL C-AP	28393.	28393.	28393.	28393.	28393.
GRANTS	462963.	461387.	463659.	459668.	455059.

APPENDIX A

AMORTIZED COST PROJECTIONS

This appendix presents Format II projections of FAA Airport and Airway System costs. These forecasts amortize future capital (F&E and R&D) expenditures over an assumed life of 15 years at a 10% capital recovery rate. This is consistent with OMB guidelines and the 1973 Cost Allocation Study.

Baseline cost projections in FY76 constant and current dollars comprise Tables A-1 and A-2. Corresponding alternative projections are found in Tables A-3 and A-4.

TABLE 5-4

ALTERNATIVE TOTAL COSTS
CURRENT DOLLARS (MILLIONS)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
B&E	75.0	85.0	89.8	94.9	100.4	106.0	111.7	117.7	124.4	131.0
PEL										
CENTERS	46.5	62.1	59.2	50.3	57.4	61.8	55.6	95.6	170.3	201.3
TOWERS	83.3	84.8	127.2	130.7	141.7	184.4	215.2	183.2	184.6	190.5
FSS	16.4	47.1	56.9	66.7	79.9	75.2	53.3	45.2	25.1	26.3
MAINT	35.5	54.8	84.8	114.0	112.9	93.6	109.3	127.2	126.9	96.1
OTHER	18.0	28.5	32.5	30.3	34.2	38.3	43.7	53.7	45.8	54.2
TOTAL PEL	200.0	277.3	360.7	392.0	426.1	453.2	477.1	504.9	552.7	568.4
OSH										
CENTERS	315.8	340.1	361.7	386.5	405.3	419.5	426.7	437.7	409.9	406.5
TOWERS	196.1	218.2	239.0	263.1	295.2	325.5	351.1	381.3	415.8	453.7
FSS	306.8	334.7	362.8	398.2	426.9	456.6	482.5	509.3	529.3	556.3
MAINT	170.8	171.8	187.9	207.1	229.6	253.9	276.6	300.5	326.8	353.2
OTHER	115.5	122.6	129.6	134.1	139.0	143.7	148.2	152.8	157.9	162.5
TOTAL OSH	1172.4	1258.2	1359.0	1473.0	1578.4	1678.9	1761.7	1863.1	1927.5	2026.6
SUPPORT										
ADM & ST	146.7	165.1	177.8	192.7	204.4	215.3	223.7	232.9	231.4	237.4
ADM MGT	153.4	172.4	187.1	202.6	220.7	240.3	260.2	280.0	304.1	329.0
DEV DIS	9.2	10.4	11.3	12.2	13.3	14.9	16.4	17.7	19.3	21.0
A-E ADM	7.2	8.7	9.2	9.7	10.3	10.8	11.4	12.0	12.7	13.4
CENT TBN	20.4	27.0	28.2	31.6	33.8	36.4	39.1	42.1	45.5	48.7
LIB, SES	77.2	93.0	100.2	108.6	116.8	124.8	131.7	139.3	144.2	151.5
TOTAL SUPP	565.8	643.8	694.3	750.9	806.8	863.5	915.3	969.9	1012.2	1068.8
FIELD	21.9	23.3	24.6	26.0	27.5	29.0	30.6	32.2	34.1	35.9
MTL CAF AF	30.6	32.5	34.3	36.3	38.4	40.5	42.7	45.0	47.5	50.1
GRANTS	524.3	555.0	590.0	625.0	645.0	675.0	705.0	740.0	775.0	805.0
TOTAL	2567.1	2875.1	3152.8	3398.1	3622.5	3846.1	4044.1	4272.8	4473.3	4685.8

TABLE 5-2

BASELINE TOTAL COSTS
CURRENT DOLLARS (BILLIONS)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
B&C	75.0	85.0	89.8	94.9	100.4	106.0	111.7	117.7	124.4	131.0
F&E	46.5	61.5	78.8	126.0	103.8	62.3	81.4	93.4	116.3	131.3
ICERS	83.3	75.5	95.9	113.2	124.9	110.2	108.6	114.5	116.5	124.9
FSS	16.4	9.9	44.0	49.0	54.0	58.0	50.0	58.0	50.0	30.0
MAVADS	35.9	48.6	74.1	62.5	66.3	62.3	62.2	62.0	62.4	63.4
CIBER	18.0	30.1	31.9	33.3	34.8	36.2	37.5	38.8	40.5	42.5
TOTAL F&E	200.0	225.4	324.7	383.9	383.8	329.0	339.5	366.7	385.8	392.1
O&M	345.8	340.1	361.7	386.5	433.7	478.2	516.3	560.2	610.8	666.6
CENTERS	196.1	218.2	239.0	263.1	295.2	325.5	351.4	381.3	415.8	453.7
ICERS	306.8	332.7	362.8	398.2	439.6	484.2	526.6	570.4	619.1	667.9
FSS	170.8	171.8	187.9	207.1	229.6	253.9	276.8	300.5	326.8	353.2
CIBER	40.4	43.7	46.1	48.7	51.5	54.4	57.3	60.4	63.9	67.3
TOTAL O&M	1172.4	1258.2	1359.0	1473.0	1628.1	1783.3	1923.6	2076.8	2250.0	2431.8
SUPPORT	146.7	165.1	177.8	192.7	214.3	236.2	255.5	277.5	304.8	327.6
ADM & ST	153.4	172.4	187.4	202.6	220.7	240.3	260.2	280.0	304.1	329.0
ADM REL	9.2	10.4	11.3	12.2	13.3	14.9	16.4	17.7	19.3	21.0
CEP DR	7.2	8.7	9.2	9.7	10.3	10.8	11.4	12.0	12.7	13.4
A-P ADM	20.4	27.0	29.2	31.6	33.8	36.4	39.1	42.1	45.5	48.7
CENT TEN	77.2	93.0	100.2	108.6	119.9	131.2	141.5	152.8	165.5	178.7
FIN, S&S	151.7	167.4	179.6	193.6	212.0	230.5	247.7	266.3	287.2	309.0
TOTAL SUPP	565.8	643.8	694.3	750.9	824.4	900.4	972.1	1048.4	1136.0	1227.4
FEED	21.9	23.3	24.6	26.0	27.5	29.0	30.6	32.2	34.1	35.9
MTL CAF AF	30.6	32.5	34.3	36.3	38.4	40.5	42.7	45.0	47.5	50.1
GRANTS	521.3	555.0	590.0	625.0	645.0	675.0	705.0	740.0	775.0	805.0
TOTAL	2587.1	2823.2	3116.8	3389.9	3647.4	3863.1	4125.6	4426.8	4752.7	5073.2

5. RESULTS

Format I baseline projections of FAA Airport and Airway System costs from FY77 through FY86 are presented in FY76 constant dollars in Table 5-1 and in current dollars in Table 5-2. Corresponding projections of expected alternative costs are found in Tables 5-3 and 5-4. Respective Format II (amortized) projections are shown in Appendix A.

The heavy investment in improved air traffic technology is expected to exceed baseline F&E spending by \$620 million in undiscounted FY76 dollars over the ten year period of the study. As a result, however, increased controller productivity and reductions in operations and maintenance requirements realize a savings of \$775.5 million in O&M costs and \$290.2 million in support costs during the same period.

etc. and amounts to 40% (\$7.6M) of the total savings in O&M. The remaining 60% (\$11.4M) is attributable to maintenance and consists of maintenance manpower costs and replenishment of spare modules and parts. The savings are accommodated in the alternative cost base by reducing the corresponding baseline operations and maintenance items.

Savings in operational costs result from decreased staffing requirements at en route and terminal facilities due to increases in controller productivity. Such productivity gains are embodied in the alternative analysis by the application of productivity factors to baseline staffing estimates. These factors are derived from a 1976 MITRE study on controller productivity in the UG3RD environment (References 5 and 6) and a later computer model that was developed to permit flexible forecasting of controller staffing requirements at each type of control facility as a function of activity statistics (Reference 3).

The controller productivity studies assume no gains (factor = 1.00) prior to 1981. Implementation of pre-data link automation is expected to create productivity gains starting in 1981 and linearly increasing through 1985. Gains attributable to advanced data link automation programs are assumed to begin in 1986. Table 4-1 summarizes the productivity factors and respective weighting factors associated with en route control facilities and various types of terminal control facilities. The productivity factors are determined by the ratio of the staffing requirements of the improved systems to the staffing requirements of the baseline system. The weighting factors are based on the expected percentage of staffing requirements for each class and are used for aggregating subsets of terminal facilities for use in the cost base development. Appendix B presents baseline staffing projections that might be expected if historical trends in technology were to continue and similar projections adjusted to reflect productivity gains associated with implementation of the alternative UG3RD enhancements.

Another major program that is expected to assert significant savings in O&M costs is the Second Generation VORTAC System. Implementation of the Second Generation VORTAC (with Remote Maintenance Monitoring System) is currently planned by the FAA Office of Airway Facilities to occur during the period Spring 1980 to Spring 1983. The potential savings in O&M of implementing a 50% dual solid state system versus the baseline option of retaining (and partially replacing with solid state) the current VOR/VORTAC tube system is \$19M per year*. Since implementation of the new system is expected to be uniform over the implementation period, O&M savings is expected to increase linearly to the \$19M level from FY81 to FY83. The operational element includes flight checks, telephone line costs, utilities, ground transportation,

*A.N. Joglekar, "Economic and Performance Analysis of the Second Generation VORTAC," MTR-7140, The MITRE Corporation, March 1976

4. COST PROJECTION PROCEDURES

As discussed in Section 3, two cost bases are developed in this study: (1) a baseline projection of existing relationships between system costs and activity levels and (2) an alternative projection assuming implementation of UG3RD and traffic control enhancements. To assure that the two cost bases are comparable requires consistency in the methods used to forecast the two sets of costs. Consistency is achieved by first creating a set of baseline forecasts using econometric methods of Section 3.2.1. The alternative cost base is then developed from the baseline projections by integrating "engineering" techniques (component pricing, productivity factors, etc.) to account for the effects of UG3RD programs.

The major distinction between this approach and that of the 1973 Cost Allocation Study is the use of econometric models to create the foundation forecasts. System component pricing was also considered by this study as a possible means to provide the cost bases. However, it was rejected because of problems in collecting sufficient and reliable data. Also because of data problems, this study uses Format I (unamortized) costs as the primary representation of the FAA cost base. Since Format II does have appeal in a cost recovery context, amortized cost bases are included in Appendix A using a universal 15 year expected asset life and 10% capital recovery factor (in keeping with the Office of Management and Budget Circular A-94).

4.1 Baseline Cost Procedures

The ASC model generates baseline forecasts of FAA expenditures (see Section 3.2.1). Log linear production functions and linear regression equations are used to project system costs based on long-run historical relationships between costs and aviation activity measures. In budget categories where statistically valid relationships do not exist, estimates from general trends, budget documents, congressional hearings and similar sources are substituted as throughputs.

The ASC model also accounts for two recent significant changes in the Airport and Airway System which are not reflected in long-run production functions or trends. Testimony at appropriation hearings indicates that productivity of controllers at en route control centers is increasing at an annual rate of about 3 percent. The assumption made in this study is that these are short term gains continuing through FY1980 and then leveling off throughout the remainder of the analysis period. These productivity gains are incorporated in the baseline projections

APPENDIX C

GLOSSARY

A.C./ AC	AIR CARRIER
A-P/ AE/ ARPT	AIRPORT
AAT	FAA AIR TRAFFIC SERVICE
ADAP	AIRPORT DEVELOPMENT AID PROGRAM
ADM/ ADMIN	ADMINISTRATION
ADV	ADVISORY
APTN	AERONAUTICAL FIXED TELECOMMUNICATIONS NETWORK
AOPA	AIRCRAFT OWNERS AND PILOTS ASSOCIATION
ARSR	AIR ROUTE SURVEILLANCE RADAR
ARTCC	AIR ROUTE TRAFFIC CONTROL CENTER
ARTS	AUTOMATED RADAR TRAFFIC CONTROL SYSTEM
ASC	ADMINISTRATIVE SCIENCES CORPORATION
ASR	AIRPORT SURVEILLANCE RADAR
ATC	AIR TRAFFIC CONTROL
AVP	FAA OFFICE OF AVIATION POLICY
C-AP	CAPITOL AIRPORTS
CAB	CIVIL AERONAUTICS BOARD (SEE ALSO TRACAB)
CAP	CAPITOL
CENT	CENTRALIZED
CONUS	CONTINENTAL UNITED STATES
CSC	COMPUTER SCIENCES CORPORATION
CTR	CENTER (EN ROUTE)
DCA	WASHINGTON NATIONAL AIRPORT
DCS	DATA COMMUNICATIONS SYSTEM
DEV	DEVELOPMENT
DIR	DIRECTION
DME	DISTANCE MEASURING EQUIPMENT
DOD	DEPARTMENT OF DEFENSE
DOT	DEPARTMENT OF TRANSPORTATION
E&D	ENGINEERING AND DEVELOPMENT
F ST/ FLT STDS	FLIGHT STANDARDS
F&E	FACILITIES AND EQUIPMENT
F,E&D	FACILITIES, ENGINEERING AND DEVELOPMENT
FAA	FEDERAL AVIATION ADMINISTRATION
FAC	FACILITY
FREQ	FREQUENCY
FSS	FLIGHT SERVICE STATIONS
FY	FISCAL YEAR
G.A./ GA	GENERAL AVIATION
GAMA	GENERAL AVIATION MANUFACTURERS ASSOCIATION

GLOSSARY
(cont'd)

S&S	STAFF AND SUPPORT
SRMC	SHORT RUN MARGINAL COSTS
SUP	SUPPORT
TACAN	TACTICAL AIR NAVIGATION AID
TCS	TECHNICAL CONTROL SERVICE
TR	TRAFFIC
TRACAE	TERMINAL RADAR CONTROL FACILITY COLOCATED WITH A CONTROL TOWER
TRACON	TERMINAL RADAR CONTROL FACILITY
TRN	TRAINING
TWEB	TRANSCRIBED WEATHER BROADCASTS
TWR	TOWER (TERMINAL)
U.S.	UNITED STATES
UG3RD	UPGRADED THIRD GENERATION
UHF	ULTRA HIGH FREQUENCY
UNICOM	AERONAUTICAL ADVISORY STATION
VCS	VOICE COMMUNICATIONS SYSTEM
VFR	VISUAL FLIGHT RULES
VHF	VERY HIGH FREQUENCY
VOR	VHF OMNI-RANGE (NAVIGATION AID)
VORTAC	COLOCATED VOR AND TACAN

APPENDIX D

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APPENDIX E

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